SEARCH FOR ULTRA HIGH ENERGY γ- RAYS FROM VARIOUS SOURCES.

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I. Introduction.

Recent discoveries of the high energy cosmic ray point sources, /Dzikowski et al., 1980, 1981, Samorski and Stamm 1983a, Lloyd-Evans et al., 1983, Protheroe et al., 1984/ interpreted as due to ultra high energy γ- rays, called our attention to the early works on the diffuse ultra high energy γ-rays /Firkowski et al., 1961, Suga et al., 1963/. One of the main puzzles in the investigations of the point sources is the fact, stated by the Kiel group /Samorski and Stamm, 1983b/ and to some extent confirmed by us /Dzikowski et al., 1983/, that the excess showers are not so muon poor as they should be in the case of their photon origin. That conclusion has also been in a sense, confirmed by recent reports about detection of a signal from Cyg X-3, in the underground muon experiments /see for instance Bartelt et al., 1984/. It should be also reminded that in the above mentioned early works on the diffuse photon showers /Gawin et al., 1965/ it has been found that the muon content in those showers is clearly higher than that expected for photon initiated showers /Wdowczyk, 1965/.

II. Contribution of the point sources to the diffuse flux the excess showers.

It has been pointed out by Wdowczyk and Wolfendale/1983/ that certain number of the point sources can in principle explain anisotropies of cosmic rays around 10^{16} eV. Another question which arrises here is if the showers from the point sources could be related to the muon poor showers.

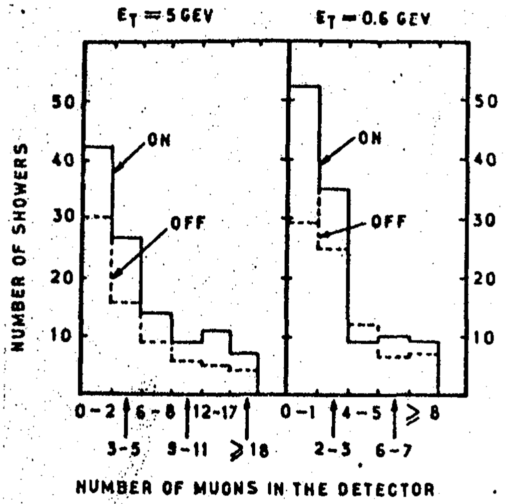

Figure 1. Comparison of the muon content in the showers from the Crab direction with that in the normal showers.

The first important observation here is that shown in figure 1 taken from our earlier paper /Dzikowski et al., 1983/. That figure shows the muon content in the excess showers from the general direction of the Crab Nebula. As it can be seen the excess showers are relatively muon poor when we consider the low energy muons, whereas they appear to be rather normal in respect to the muons of higher energies. That effect, very puzzling by itself may explain why the muon poor showers have been found when low energy muon detectors were used but not for the high energy muons.

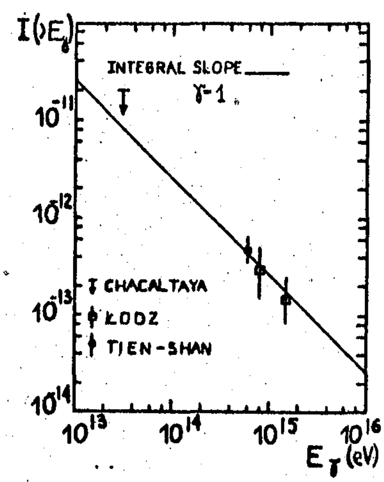

Fig 2. Integral energy spectrum of the muon poor extensive air showers.

The second important point is illustrated in figure 2 where the energy spectrum of the muon poor showers is shown for all existing data /including recent observations of the hadron less showers by Nikolski at al.1984/ The main characteristic of the spectrum is the fact that similarly as in the case of the excess showers from the point sources it appears to be very flat, much flatter then in the case of proton initiated showers.

Those two fact makes the hypothesis about the common origin of the muon poor and the point sources excess showers plausible and worthwhile of further investigation.

III. Galactic latitude distribution of the extensive air showers with different muon content.

In our analysis we have usedthe showers collected in Łódź from 1975. In figure 3 the Galactic latitude distribution of the showers with $N_e > 10^6$ and different muon content are shown and compared with the expectations on the assumption of isotropy. The expected distributions were obtained using the method develop the Haverah Park group /Astley et al., 1981/ and discussed in details by Wdowczyk and Wolfendale /1984/. Essence of the method is that the data are divided into narrow strips of declination. For each strip the expected distribution of the Galactic latitudes is calculated assuming isotropy.

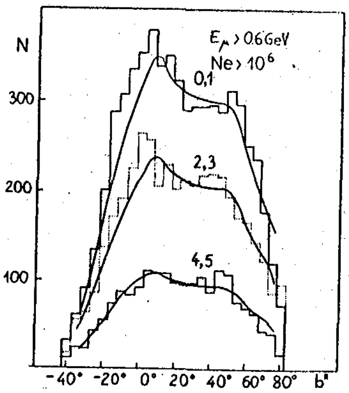

Fig 3. Galactic latitude distribution of the showers with $Ne>10^6$ and various muon content /threshold energy 0.6GeV/. Predicted curves calculated as described in the text. Figures gives number of μ actually detected.

The contributions from the different strips are added according to the weights given by the experimental data. The expected curves in figure 3 are normalised to the experimental histograms in the interval $b = 17.5° - 77.5°$.

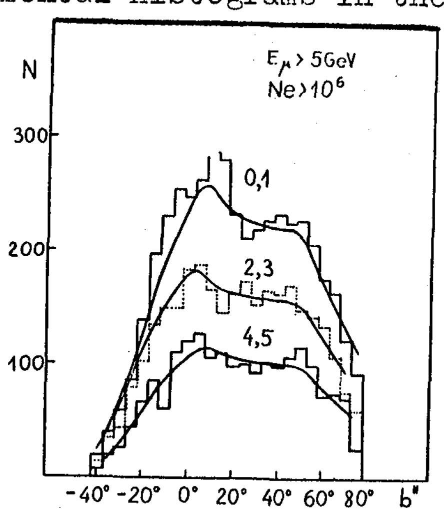

Fig 4. The same as in fig 3 but for muon energy threshold 5 GeV.

It is seen that at low latitudes and low muon content there exist an excess of showers compared with the expectation. Similarly as in figure 1 the excess is most pronounced for the showers with 0 - 1 muons in the detector, less pronounced for 2 - 3 and practically not seen for 4 - 5 muons.The excess in the interval $b=-17.5°$ to $b=17.5°$ amounts to 234 showers for 0 - 1 muons and 105 for 2 - 3.

The excess of showers with low latitudes may be noticed for the high muon energy threshold /5 GeV/ but in that case is less marked perhaps due to the fact that it is not disapearing with increasing muon number /figure 4/ but does not seem to exist for showers with $N_e < 10^6$ /figure 5/.

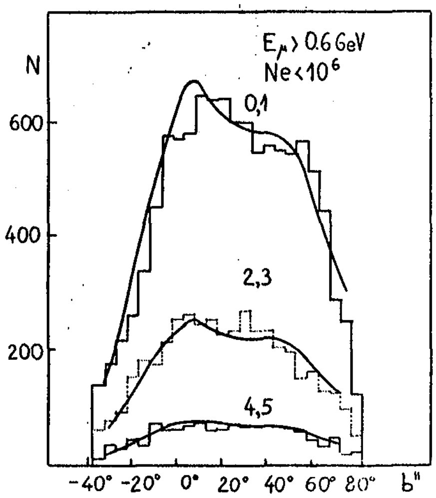

Fig 5. The same as fig 3 but for smaller showers N_μ=/ 3÷10 /×10^5.

IV. Conclusions.

It seems that there exist an excess of showers from the Galactic plane on the level 1-2 % at energies just above 10^{16} eV. The excess shower from the Galactic plane seems to be very similar in properties to excess showers from the point sources /flat spectrum, deficit of low energy muons/. Those facts suggest that the excess from the Galactic plane are probably due to summing up of the contribution from individual point sources. That in turn suggest that those sources are rather numerous.

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